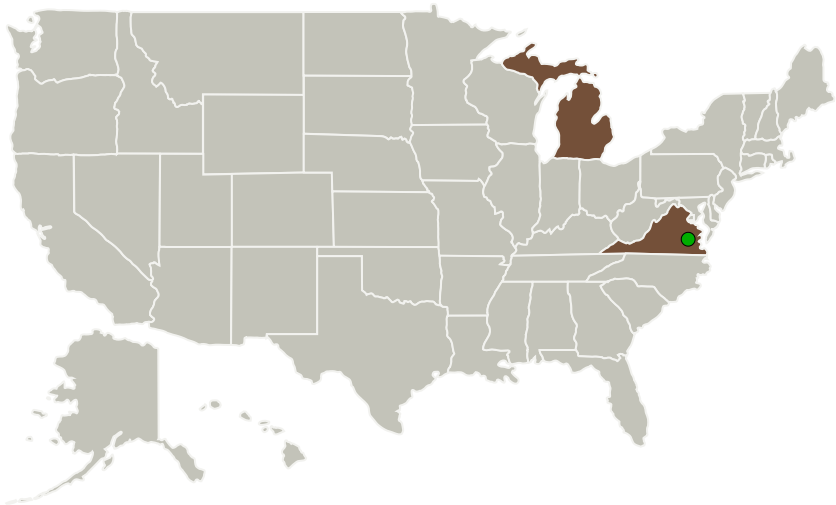
Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities, Phase II

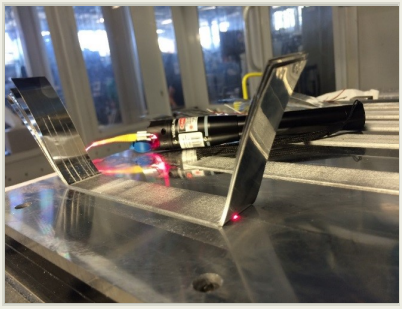
Completed Technology Project (2016 - 2019)

Project Introduction

This Phase II development program will utilize a novel new 3D printing process to produce multifunction aluminum parts with integrated health monitoring sensors. In particular, Ultrasonic Additive Manufacturing will be used to embed optical fiber strain sensors anywhere in a metal part that can subsequently be used for structural health monitoring (SHM). Success in this program enables real time strain and temperature measurements throughout a structural aluminum part that complements the integrated system of data, models, and other analysis tools to represent an aerospace vehicle over its entire life cycle. This new capability is in direct support of the NASA Virtual Digital Fleet Leader / Digital Twin program, a concept which combines as-built vehicle components, as-experienced loads and environments, and other vehicle-specific characteristics to enable ultrahigh fidelity modeling of aircraft and spacecraft or their components throughout their service lives. When augmented with real time data, Digital Twin provides actionable information for making decisions now (diagnosis) and for the future (prognosis), considering all sources of uncertainty. Data generated from this enabling work will provide the engineering design and programmatic information necessary for implementation into a flight program. In this effort we will contribute to NASA's plans to prepare for future generations of vehicles that will rely on increasingly complex, heterogeneous and multifunctional material forms with increasingly complex failure modes.

Primary U.S. Work Locations and Key Partners





Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities, Phase II

Table of Contents

Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities, Phase II

Completed Technology Project (2016 - 2019)

Organizations Performing Work	Role	Type	Location
Sheridan Solutions, LLC	Lead Organization	Industry Veteran-Owned Small Business (VOSB)	Saline, Michigan
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Michigan	Virginia

Project Transitions

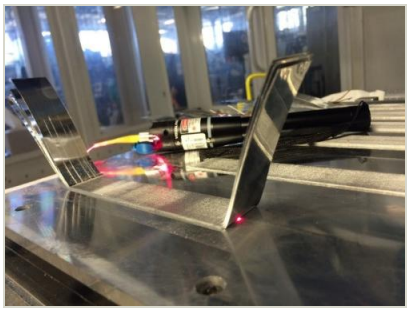
April 2016: Project Start

March 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139459)*

Images



Briefing Chart Image
Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities, Phase II *(https://techport.nasa.gov/image/137281)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Sheridan Solutions, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
John J Sheridan

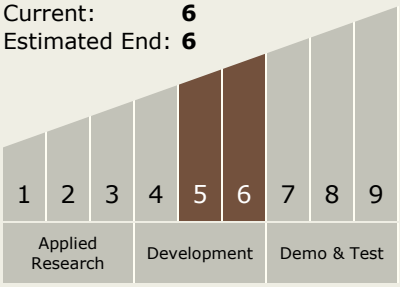
Co-Investigator:
John T Sheridan

Ultrasonic Additive Manufacturing for Multifunctional Structural Materials with Embedded Capabilities, Phase II

Completed Technology Project (2016 - 2019)

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System